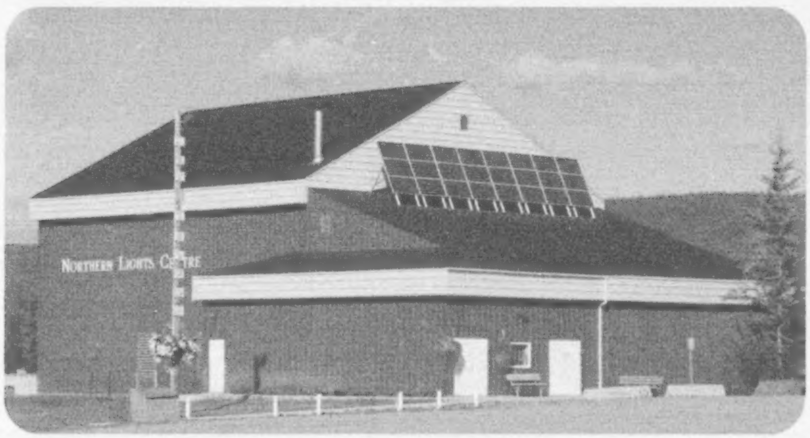
Yukon Government Solar Energy Pilot:
Performance Monitoring
Yukon Government's Energy Solutions Centre

February 2014



energy solutions centre

Yukon
Energy, Mines and Resources

Contents

1. Project Overview

This report presents the performance monitoring results of three, grid connected, solar electric (also called "photovoltaic") demonstration sites monitored by the Yukon government's Energy Solutions Centre (ESC). These grid-connected renewable systems provide some of the electricity for the buildings in which they are connected. The balance of buildings' electrical demands is delivered via the local electrical grid. These solar systems reduce the total electrical consumption of the buildings, offer an opportunity to evaluate the effectiveness of this technology in the Yukon's unique northern climate, and allow the Yukon government to build capacity and knowledge of this technology amongst Yukon contractors and public.

The first site consists of a grid-connected photovoltaic (often abbreviated as PV) system installed on the Yukon government's Main Administration Building (MAB) located in Yukon's capital city of Whitehorse. The second site also consists of a ground mounted PV system installed at the Yukon College, Whitehorse Campus. The third site consists of a roof mounted PV system on the Yukon's Northern Lights Space and Science Centre located in the community of Watson Lake (www.northernlightscentre.ca).

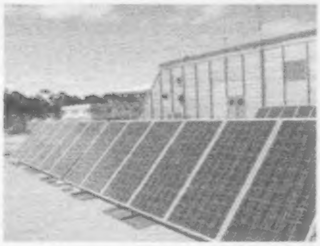
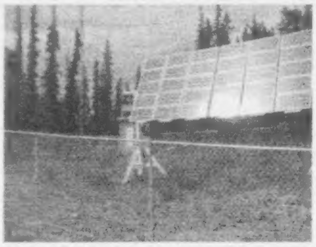
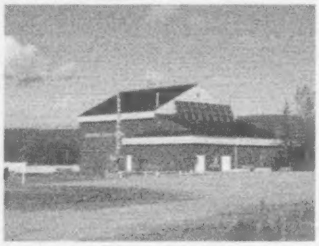




Figure 1.1: Photos of the MAB, College, and Watson Lake Space and Science Centre PV Systems

2. System Specifications

Detailed specifications for these three systems are given below:

2.1. Yukon Government Main Administration Building (MAB) PV System

The MAB PV system consists of 24 Sharp 170 watt PV modules arranged in three strings of eight for a total power at standard test conditions (STC)[1] of 4.08 kilowatts (kW). This system feeds power to the grid through an SMA SB3800U inverter. It was installed and commissioned in winter 2008.

The modules are installed on a flat portion of the roof of the MAB and mounted using a ballasted mounting system that avoids the requirement for roof penetrations that may cause leaks (a common concern with flat roofs).

[1] Standard Test Conditions (STC) represent a set of environmental values including sunlight, temperature and air density at which the power performance of the array is measured. The actual power numbers realized in practical applications are typically less than these numbers; however, STC offers an excellent means by which to compare PV systems.

The modules are oriented due south at a tilt angle of 47° from vertical. This system was commissioned in December2008 and has been operating without interruption since that time.

2.2.Yukon College Renewable Energy Demonstration Site

The Yukon College Renewable Energy Demonstration project consists of both a PV system and a small wind turbine. The PV system is made up of 30 Hoxan 50 watt PV modules arranged in a single string for a total rated STC power of 1.5 kW. This system feeds power to the grid through an SMA 1100U inverter. These panels are ground mounted on a custom made mounting apparatus. The panels are oriented due south and are currently set at a tilt angle of 64° from vertical; however, the tilt angle for this mounting system is fully adjustable.

This system was originally installed and commissioned in 1992 as an off-grid demonstration project. It was later converted to a grid-tied system in 2000. The PV system, inverter, and wind turbine were upgraded in 2008/2009 with formal monitoring of the system's performance beginning in September 2009.

2.3.Northern Lights Space and Science Centre

The Northern Lights Space and Science Centre renewable energy system consists of 24 Coenergy 185 watt PV modules that are arranged in three strings of eight for a total rated STC power of 4.4 kW. This system feeds power to the grid through an SMA 4000U inverter. It was installed and commissioned in April 2011 with monitoring starting in September 2011.

The modules are installed on a pitched portion of the roof of the building using a mounting system that allows the panels' tilt angle to exceed the roof's pitch so as to optimize snow shedding in the winter and improve the modules' orientation for best performance.

The modules are oriented due south at a tilt angle of 60° from vertical. This system has operated without incident since its original installation in the spring of 2011.

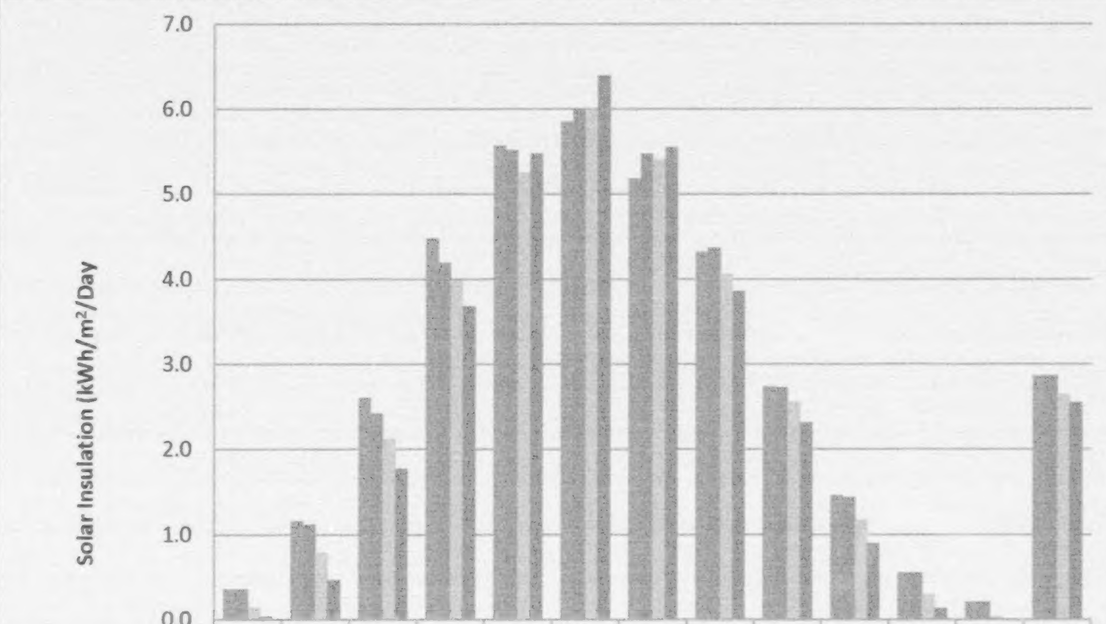
3. Yukon's Solar Resource

Yukon has significant natural resources including both wind and sun. Despite common misconceptions, Yukon has an excellent solar resource through most of the year that, on an annual basis, is comparable with many of jurisdictions that are currently leading the world in solar installation (Japan, Germany, Ontario, and the United States).

The following is a brief summary of Yukon's solar resource data collected to date.

3.1. NASA SSE Satellite Data

Figure 3.1 below gives an estimated solar irradiance[2] on a horizontal surface for various Yukon sites based on NASA SSEE satellite data collected between 1983 and 2006.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Watson Lake	0.36	1.16	2.61	4.48	5.57	5.85	5.18	4.32	2.74	1.46	0.55	0.21	2.87
Whitehorse	0.36	1.12	2.42	4.19	5.52	6	5.48	4.37	2.73	1.44	0.55	0.21	2.87
Dawson/Mayo	0.15	0.79	2.13	3.98	5.25	5.99	5.41	4.06	2.56	1.17	0.3	0.04	2.65
Old Crow	0.04	0.47	1.77	3.68	5.48	6.39	5.55	3.86	2.31	0.9	0.13	0	2.55

Figure 3.1: Daily solar irradiance on a horizontal surface NASA SSEE Satellite data[3] (1983-2006)

This data clearly shows the trend of solar resource on a horizontal surface over the course of a year and demonstrates the significant resource available even in Yukon's most northern communities.

3.2.Yukon's Measured 20 Year Average Solar Resource

Environment Canada collected solar irradiance data for the City of Whitehorse for a 20-year period between 1974 and 1994. Subsequently ESC has been collected solar data at its Whitehorse renewable energy Yukon College site from September 2009 to present. The results of Environment Canada's 20-year daily average solar irradiance versus the data collected over the past four years by ESC is shown in Figure 3.2 below.

[2] Irradiance is the density of radiation incident on a given surface usually expressed in watts per square centimeter or square meter

[3] These data were obtained from the NASA Langley Research Center Atmospheric Science Data Center, *Surface meteorological and Solar Energy* (SSE) web portal supported by the NASA LaRC POWER Project.

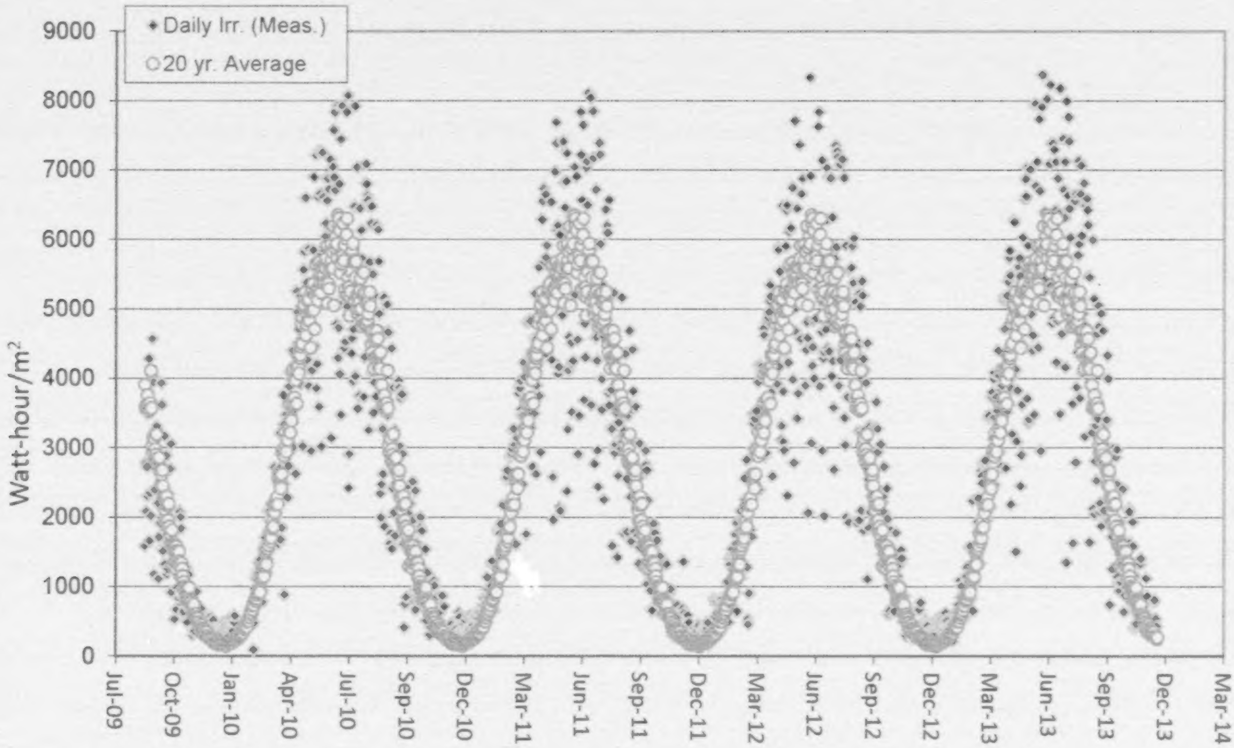


***Figure 3.2:** Daily Solar Irradiance on a Horizontal Surface; Measured (July 2009-Nov. 2013) and 20 Year Average (1974-1994)*

Figures 3.1 and 3.2 above show that the territory's solar resource is predictable and has remained relatively unchanged over the last 40 years.

The above data demonstrates the annual cycle of the solar resource in the territory; however, it is important to note that these measurements were taken, as per standard practice, on a fixed horizontal plain which is strongly biased towards mid-summer months when the sun is at its highest. In reality a more ideal orientation for total annual solar collection in the north would be a surface tilted towards the southern hemisphere. As demonstrated in Figure 3.3 below, a strongly tilted surface will result in greater solar collection during the spring and fall months with a slight compromise of decreased collection in the mid-summer months.

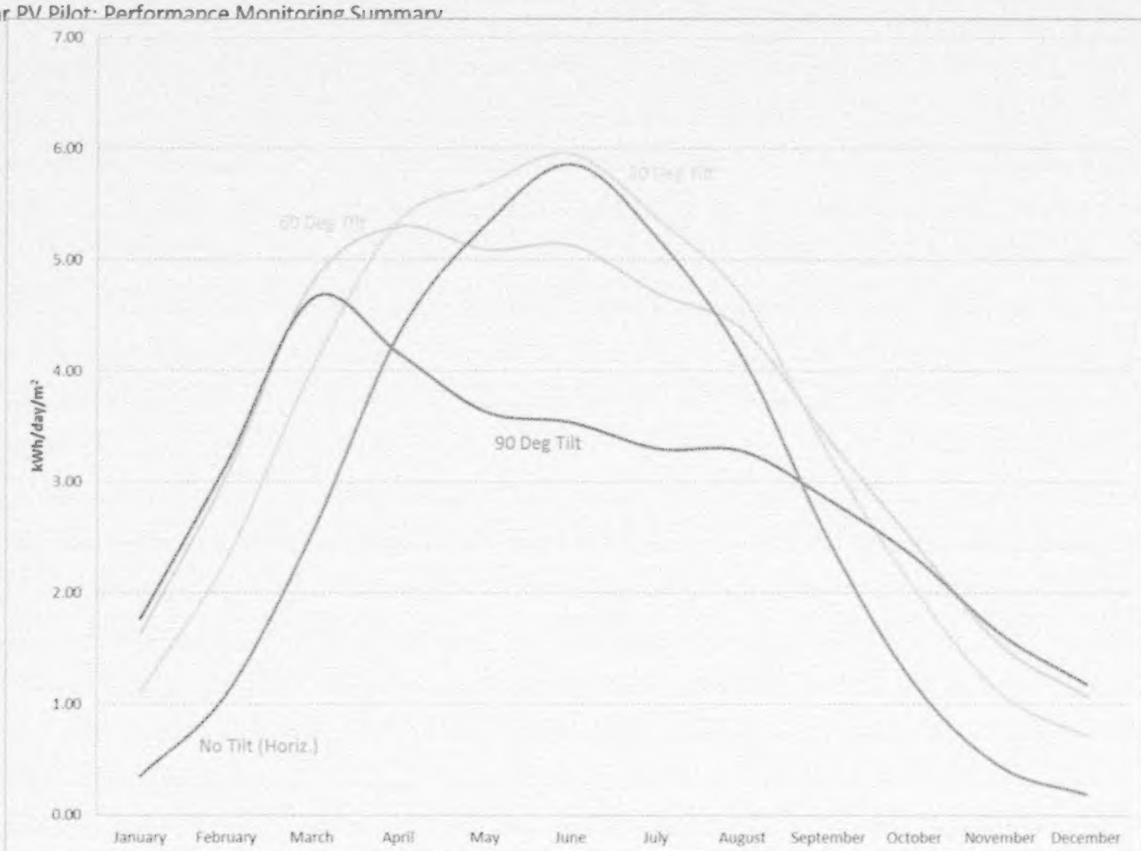


Figure 3.3: Tilt Angle effect on solar collection (RetScreen® data)

Based on RetScreen® and PVSyst® simulations the ideal tilt angle for maximum annual solar collection in the southern/central Yukon is between 45° and 55°; however, there is very little lost in annual performance with tilt angles between 40° and 60° . This is in slight contrast to the conventional understanding which states that the optimum tilt angle for such a systems should be equivalent to the latitude of the installation, which would make it close to 60° for the southern Yukon. The combination of low winter light levels, snow covering the panels, and good spring performance is likely the cause of this discrepancy.

Regardless of the cause, the reality is that the effect of tilt angle is likely not as important to annual system performance in Yukon as it is to seasonal performance (i.e., improved spring/fall performance versus improved summer performance).

It is also worth noting that, regardless of tilt angle, solar resource for the months of December and January are consistently very low due to limited sun hours and snow covering the panels.

4. Estimated/Modelled System Performance

ESC used three separate tools to evaluate the potential energy generation of these systems before installation took place: Natural Resources Canada's PV performance estimate maps, RetScreen® performance evaluation software, and the PVSyst® PV simulation software.

4.1.Natural Resources Canada (NRCan) Map of PV Potential in Canada

NRCan, CanMet, Canadian Forest Service, and Environment Canada have collaborated to develop an interactive map that offers a rough approximation of the potential for PV throughout Canada that can be found here pv.nrcan.gc.ca .

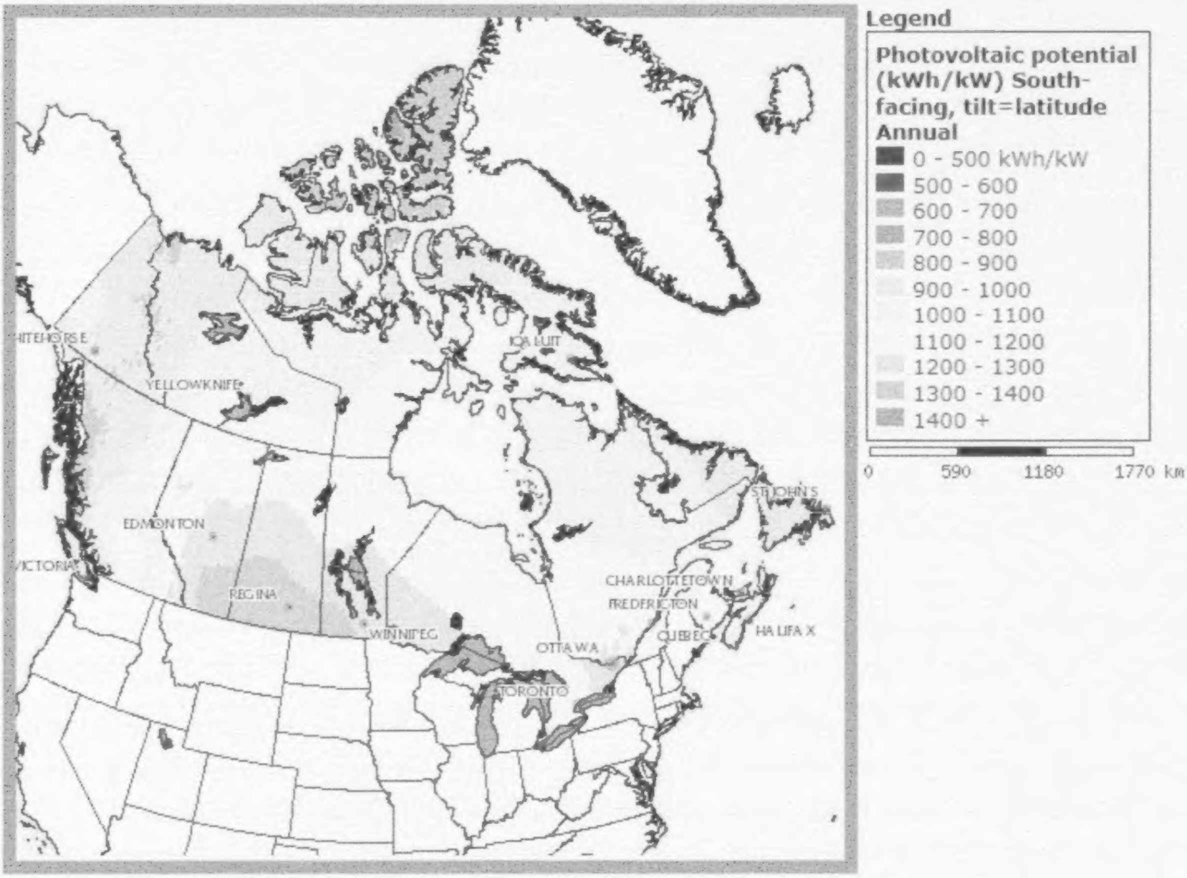


Figure 4.1: NRCan PV Potential Map of Canada

According to this tool the majority of Yukon has the potential to receive between 900 - 1,000 kilowatt hours (kWh) per kW of installed PV. This is on par with a large portion of British Columbia and only slightly lower in potential than the rest of Canada on an annual resource basis.

4.2.RetScreen® Performance Estimate for PV and Wind

RETScreen® is an Excel-based clean energy project analysis software tool developed by NRCan that helps decision makers quickly determine the technical and financial viability of potential renewable energy, energy efficiency and cogeneration projects.

RETScreen® predictions for the performance of a 1 kW PV system at an optimal tilt angle in the City of Whitehorse is approximately 1,100 kWh/year which is consistent with the NRCan Map referenced in section 4.1.

4.3.PVSyst® Performance Modelling

PVSyst® is a PC software package for the study, sizing, simulation and data analysis of complete PV systems. This software has become an industry standard used by architects, engineers and researchers needing a precise PV performance modeling tool.

PVSyst® software is able to import weather data from any site and perform a detailed and comprehensive PV system performance simulation.

PVSyst® simulations were conducted for all three of the PV installations referenced in this report. Consistent with both RETScreen® and NRCan's PV Potential Mapping tool, PVSyst predicted an annual performance of between 900 and 1,100 kWh/year per installed kW of PV. Details of how these simulations compare to the actual measured performance is given in Section 5.

5. Measured System Performance

ESC has been monitoring the performance of these three systems for several years using a remote, web based monitoring system. The following is a summary of the data collected for each of the three sites.

	Main Admin. Building (Whse)			Yukon College/NRI (Whse)			Space Centre (Watson Lake)		
Year	Meas. Annual PV Gen. (kWh/y)	Meas. Annual PV kWh/kWp/y	Meas. Vs. Simulation (% better then Sim.)	Meas. Annual PV Gen. (kWh/y)	Meas. Annual PV kWh/kWp/y	Meas. Vs. Simulation (% better then Sim.)	Meas. Annual PV Gen. (kWh/y)	Meas. Annual PV kWh/kWp/y	Meas. Vs. Simulation (% better then Sim.)
2009	4,294	1,047	6.8%						
2010	4,563	1,113	13.5%	1,264	843	0.3%			
2011	4,361	1,064	8.5%	1,230	820	-2.4%			
2012	4,309	1,051	7.2%	1,197	798	-5.0%	4,332	985	-17.6%
2013	4,544	1,108	13.0%	1,257	838	-0.2%	4,390	998	-16.5%
Average	**4,414**	**1,077**	**9.8%**	**1,237**	**825**	**-1.8%**	**4,361**	**991**	**-17.0%**

Figure 5.1: Summary of Yukon PV system Performance (2009-2013)

5.1.MAB PV System Performance

The PV system at the MAB was installed in December 2008 providing five years of performance data for this site.

Figure 5.2 below shows the PV system generation on a monthly basis at the MAB alongside the PVSyst® simulation for that system which is based on Environment Canada weather data averaged from 1974 to 1994. This chart shows that the generation at this site over the past 4 years agrees strongly with the predictions made by the PVSyst® simulation.

PVSyst® predicted the performance of this system to be approximately 4,020 kWh/year while the system actually produced an average of 4,414 kWh/year; approximately 10% above the predicted generation. Some of this increase can be accounted for by the greater than average solar resource during these five years. From 2009 through 2013 the solar irradiance in Yukon measured on a horizontal plane was approximately 3.6% greater than the 20 year average measured from 1974-1994.

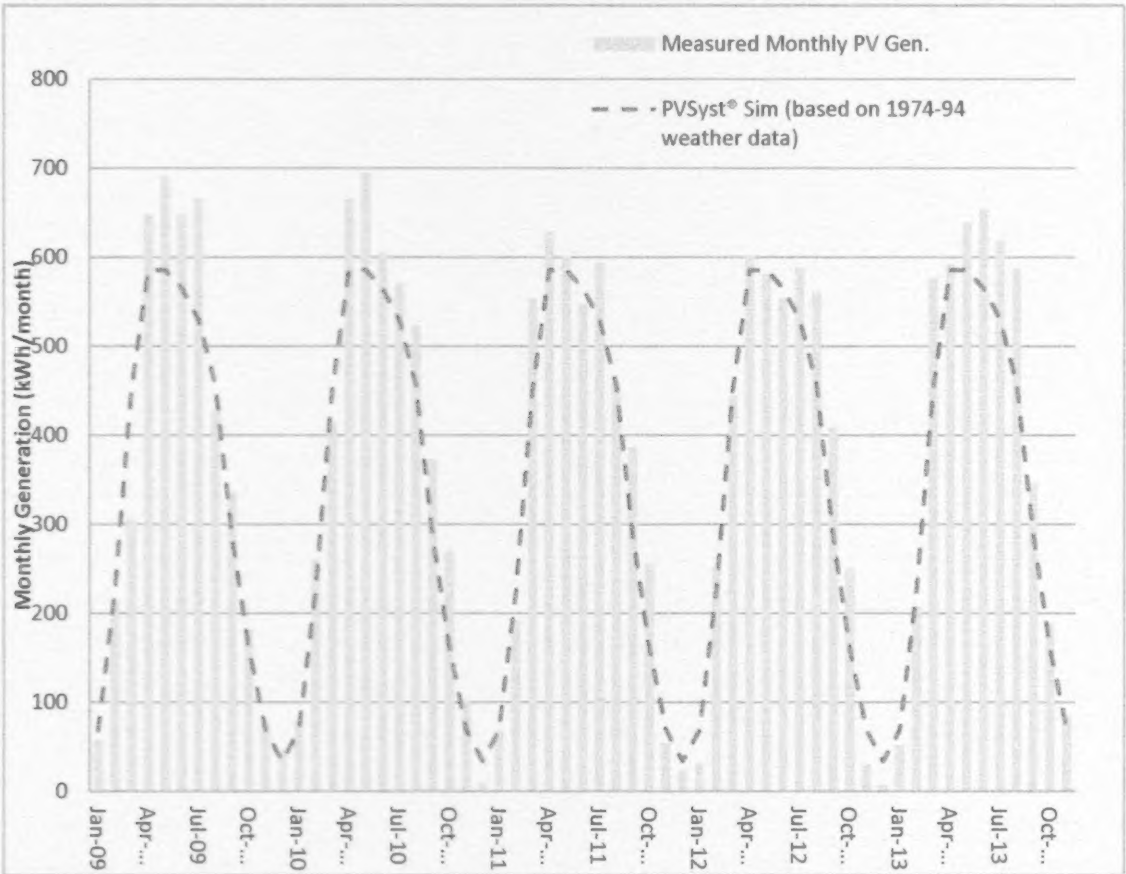


Figure 5.2: MAB PV System Performance 2009-2013

Year	Meas. Annual PV Gen. (kWh/year)	Meas. Annual PV kWh/kWp/year	Meas. Vs. Simulation (% better then Sim.)	Meas. Annual Irr. (kWh/m^2)	Meas. Vs. 1974-94 Average (% better then Av.)
2009	4,294	1,047	9.5%		
2010	4,563	1,113	16.4%	1,049	4.3%
2011	4,361	1,064	11.2%	1,043	3.7%
2012	4,306	1,050	9.8%	1,033	2.7%
Average	**4,381**	**1,069**	**11.8%**	**1,041**	**3.6%**

Figure 5.3: MAB PV System Performance 2009-2013 vs. Simulation based on 1974-94 weather data

This system averaged 1,069 kWh/year per installed kW, which is consistent with the estimates made by NRCan, RETScreen® and PVSyst® as described in Section 4 above.

5.2. Yukon College PV System Performance

The PV system at the Yukon College was originally installed in 1992 and was re-commissioned with a new inverter in 2008/2009 through a partnership between ESC and the Northern Research Institute (NRI). Data monitoring for the project began in September 2009, providing three years of performance data for this site.

Figure 5.4 below shows the PV system generation on a monthly basis at the college, alongside the PVSyst® simulation for that system, which is based on Environment Canada weather data averaged from 1974 to 1994. This chart shows that the generation at this site over the past four years is consistent with the predictions made by the PVSyst® simulation.

Year	Meas. Annual PV Gen. (kWh/year)	Meas. Annual PV kWh/kWp/year	Meas. Vs. Simulation (% better then Sim.)	Meas. Annual Irr. (kWh/m^2)	Meas. Vs. 1974-94 Average (% better then Av.)
2009					
2010	1,264	843	0.3%	1,049	4.3%
2011	1,230	820	-2.4%	1,043	3.7%
2012	1,197	798	-5.0%	1,033	2.7%
2013	1,257	838	-0.2%	1,080	7.4%
Average	**1,237**	**825**	**-1.8%**	**1,051**	**3.6%**

Figure 5.4: Yukon College PV System Performance 2010-2012 vs. Simulation based on 1974-94 weather data

PVSyst® predicted the performance of this system to be approximately 1,260 kWh/year while the system actually produced an average of 1,237 kWh/year; approximately 2% below the predicted generation. Some of this decrease is likely as a result of shading effects associated with the large number of buildings and other structures in the vicinity of the installation. It is also likely that the age of these modules may be having a small effect on performance. Despite the relatively slight decrease in performance over the prediction, this system continues to show impressive performance even after 20 years of operation in the harsh Yukon environment.

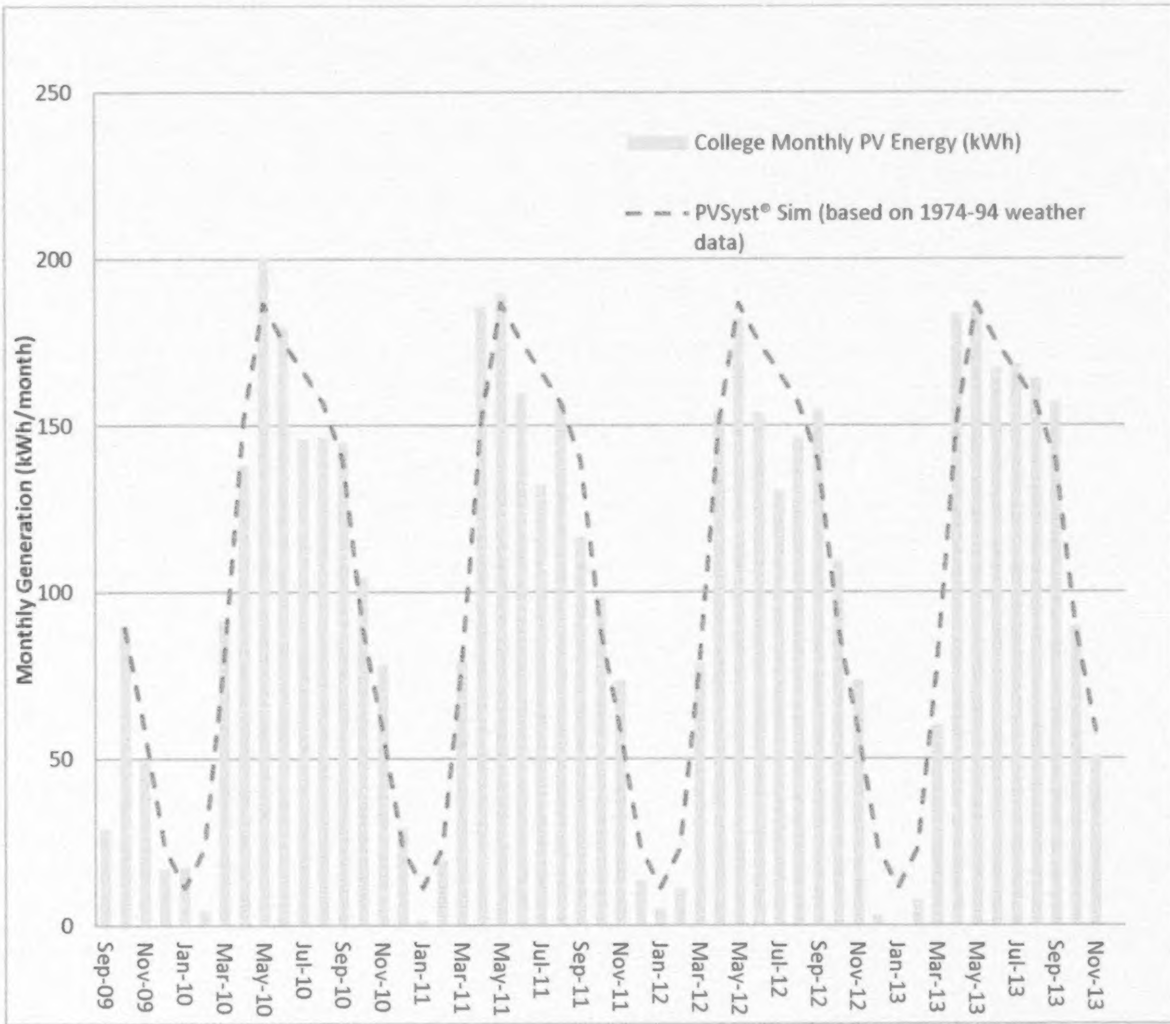


Figure 5.5: Yukon College PV System Performance 2009-2012

5.3. Watson Lake PV System Performance

The PV system at the Watson Lake Space and Science Centre was installed in April 2011 through a partnership between ESC and the Town of Watson Lake. Data monitoring for the project began in September 2011 providing two years of performance data for this site.

Figure 5.7 below shows the PV system generation on a monthly base at the Centre alongside the PVSyst® simulation for that system which is based on NASA SSEE satellite data collected from 1983 to 2006. This chart shows that the generation at this site over the past two years agrees with the predictions made by the PVSyst® simulation.

PVSyst® predicted the performance of this system to be approximately 5,257 kWh/year while the system actually produced an average of 4,361 kWh/year; approximately 17% below the predicted generation. Some of this decrease is likely as a result of significant snow cover on the panels in this area which results in very poor performance during the winter months and is not captured by the simulation software due to this simulation's reliance on satellite data (inherently less reliable then data collected terrestrially such as the data for Whitehorse). A more detailed evaluation of the performance of this system may be warranted based on site solar resource data collection.

Despite lower than predicted performance from the PVSyst® simulation, this system averages 991 kWh per kW of installed PV per year which is very much consistent with both RETScreen® and NRCan predictions for Yukon and is a respectable performance that proves the viability of this technology in the Watson Lake area.

Year	Meas. Annual PV Gen. (kWh/year)	Meas. Annual PV kWh/kWp/year	Meas. Vs. Simulation (% better then Sim.)
2012	4,332	985	-17.6%
2013	4,390	998	-16.5%
Average	**4,361**	**991**	**-17.0%**

Figure 5.6: Watson Lake Science Centre PV System Performance 2012-2013 vs. Simulation based on NASA Satellite data

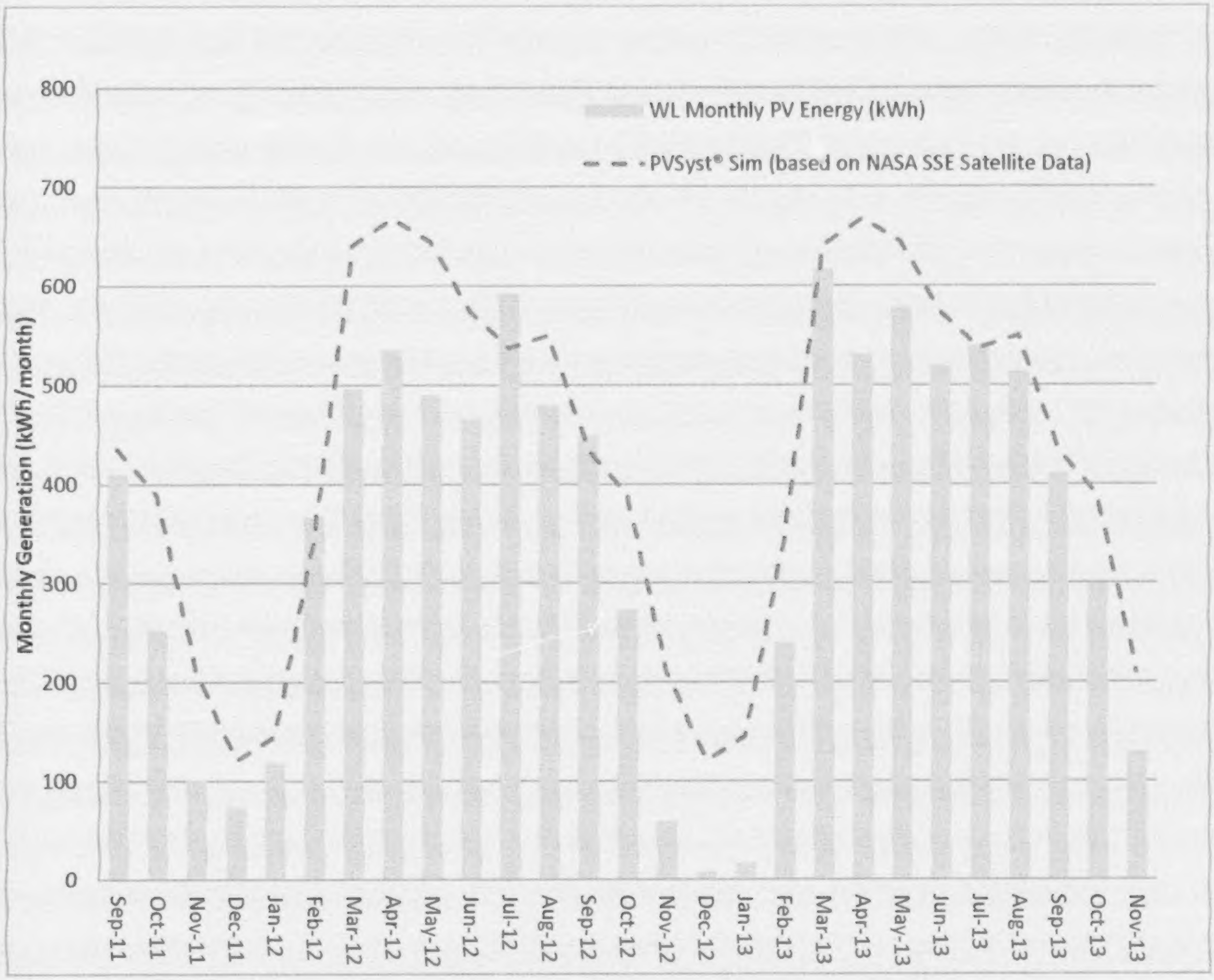


Figure 5.7: Watson Lake Space and Science Centre PV System Performance 2011-2013

6. Operations and Maintenance

ESC managed the installation of both the MAB PV system and the Watson Lake Space Centre system in 2008 and 2011 respectively. Performance monitoring of these two systems began soon after system commissioning was complete. ESC worked with the NRI to make improvements to the existing PV system at the Yukon College in 2008/2009 including replacing the inverter with a more efficient and appropriate technology as well as removing panels that had been damaged by a vandalism incident.

Over the course of the five years that ESC has monitored these systems they have operated without interruption. No maintenance has been required outside of the optional sweeping of snow from modules during the winter months. To date there have been no costs associated with the operations and maintenance of these three systems.

The Yukon College PV system was originally installed in 1992. Limited data monitoring for the system existing until the system was re-commissioned in 2009. Through discussions with those involved in the operation of the system during the years between 1992 and 2008, it appears that this system operated without any challenges with the exception of a vandalism incident that resulted in 25% of the modules being damaged. Despite the damage that occurred to these modules the system was found to be operational in 2008 when ESC began working with NRI to undertake the upgrades. These PV modules continue to perform well today despite being in operation in Yukon's harsh environment for over 20 years.

7. Economic Analysis

While the monitoring of these three systems over the past several years has proven definitively that solar PV system work very reliably in Yukon, it has yet to be established that these systems are economically viable.

7.1.Current Installed Cost

Over the course of monitoring these three systems the installed cost of PV systems has dropped dramatically. The following table shows a summary of the installed cost of the MAB and Watson Lake Space and Science Centre PV systems along with a more recent installation that ESC has undertaken in Yukon's Kluane area in partnership with the Kluane First Nation government.

Year	Installation	$/Watt Installed
2008	Main Administration Building	$ 17.10
2010	Watson Lake Northern Lights Centre	$ 8.20
2012	Kluane Maintenance Building	$ 4.88

Clearly the installed cost of PV systems has declined considerably over the past five years. This trend is likely to continue as equipment prices continue to drop and local installation capacity increases.

Costs for recently installed, large scale (>50 kW) PV systems in the Edmonton area have dropped to under $3/Watt[4] installed. It is likely that Yukon could see similar numbers over the next 10 years.

7.2.Comparison with Alternatives

In evaluating the economic viability of renewable electricity production technologies it is appropriate to ask two questions:

1. Is the technology cost competitive with the current generation technologies in a given region?
2. Is the technology cost competitive with the likely new sources of generation that could be developed should they be required?

4 Based on discussion with Alberta solar energy expert Gordon Howell of Howell Mayhew Engineering.

Yukon's electrical system is made up of one large interconnection grid called the Yukon Integrated System (YIS) and a handful of smaller remote communities/individuals that are not connected to this system. The YIS receives the majority of its generation from legacy hydro resources that were developed several decades ago and now produce electricity at a very low price. However, increasing electrical loads in the territory are seeing increased demand for diesel generation during periods of significant peak energy demand and/or low hydro resource availability. This increased demand may soon require new generation options to be developed.

Communities/individuals that are not connected to the YIS are reliant on costly diesel generation for 100% of their electricity supply.

It is unlikely that any new generation option, including solar PV, will ever be able to compete with the territory's legacy hydroelectric facilities from an economic perspective. The age of these facilities combined with the relative high quality of the resource allows power to be produced from these assets at a very low cost. With that understanding Figure 6.1 below compares the economics of PV systems in Yukon with the potential of offsetting existing diesel generation, and potential liquefied natural gas (LNG) generation projects using the Levelized Cost of Energy (LCOE)[5] method.

Like wind generation, solar PV generation is a non-dispatchable technology, meaning that its power output cannot be easily adjusted to match demand. This does not present as significant a challenge as it may seem because most electrical grids are able to accept as much as 20% of their generation from non-dispatchable sources without any mitigation. Even higher levels of non-dispatchable generation are possible if appropriate storage and/or load shedding/control is incorporated. However, it is extremely difficult for non-dispatchable generation technologies to completely replace dispatchable forms of generation like diesel, natural gas, and/or hydro. Some form of load matching is generally required, particularly during periods of peak electrical demand. For this reason this comparison only investigates the economics of offsetting a portion of generation from these traditional facilities and the costs associated with LNG and diesel given below do not include the cost of capital infrastructure and are therefore not a true LCOE for these technologies but rather a simple levelized avoided cost savings.

From Figure 6.1 it is clear that even at the current cost of installed PV systems and modest predictions for diesel cost escalations, PV is very competitive with the avoided cost of diesel and extremely competitive with diesel generation in the remote community of Old Crow where the cost of imported diesel fuel is quite high. PV is less competitive with today's estimated avoided cost of LNG generation; however, the current North American price for LNG is very low and likely to increase in the future as the product becomes open to the world market and demand for the product grows. Based on this analysis, if LNG sees a fuel price increase in the range of 6-9% per year or greater, PV would again be a competitive option for offsetting the costs associated with these thermal plants.

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[5] The Levelized Cost of Energy (LCOE) is the price at which electricity must be generated from a specific source to break even over the lifetime of the project. It is an economic assessment of the cost of the energy-generating system including all the costs over its lifetime: initial investment, operations and maintenance, cost of fuel, and cost of capital.

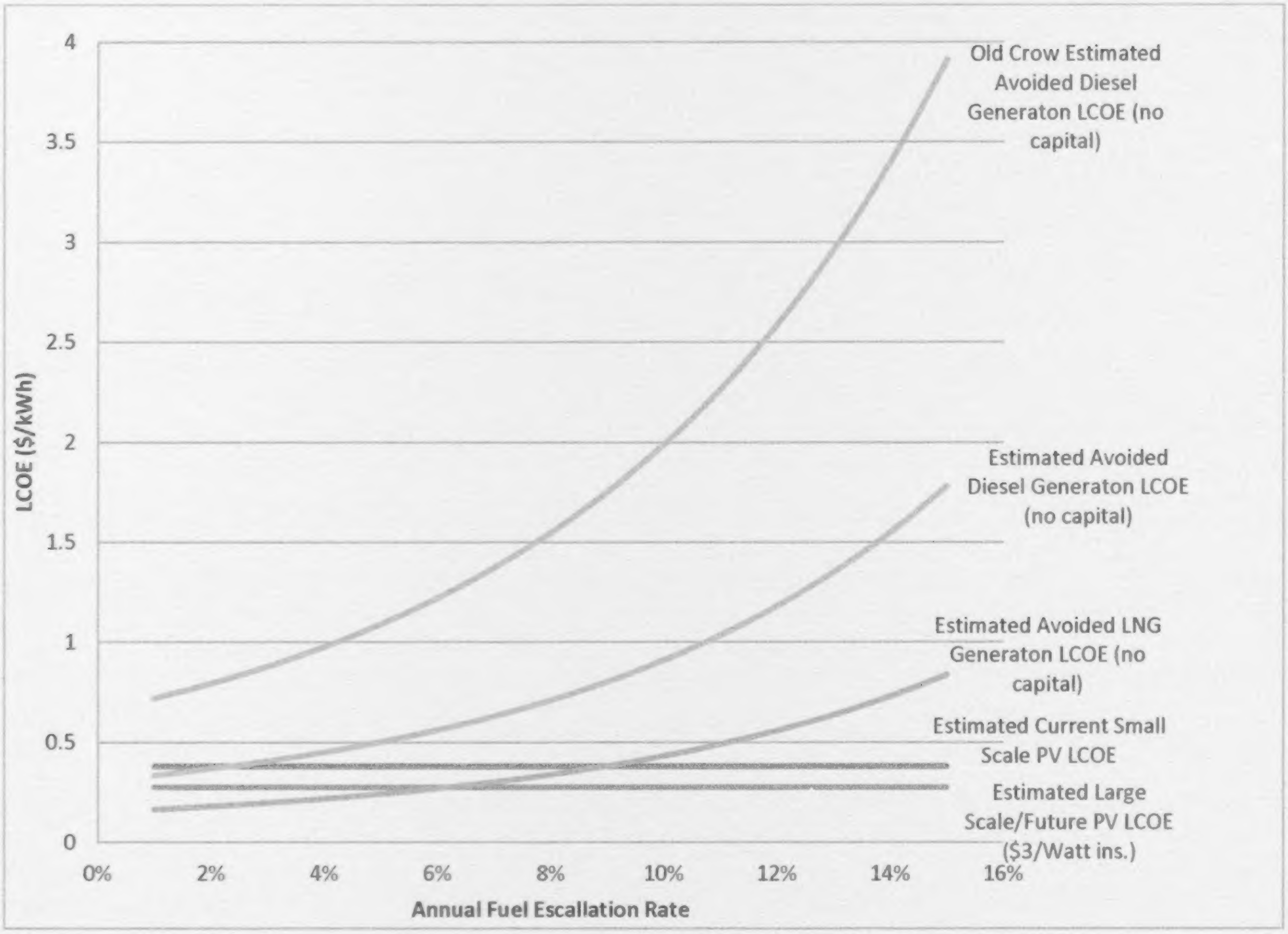

Figure 6.1: LCOE comparison of PV and LNG/Diesel Avoided Cost

7.3.Micro-Scale Utility Customer PV System Economics

In October 2013, the Yukon government released its micro-generation policy which allows Yukon residents to connect their renewable energy systems to the grid enabling them to offset some of their own electrical consumption while receiving financial compensation for any power they export to the grid. Participants are compensated for electricity which is exported to the grid at a rate of $0.21/kWh on the YIS and $0.30/kWh in remote diesel communities.

Figure 6.2 below shows the current simple payback for a residential PV system based on an installed PV system cost of $4.90/Watt (the most recent system installation cost known to ESC), an assumed annual generation of approximately 1,000 kWh/kWp/year, and an annual household energy consumption of 10,000 kWh.

System Size (kW)	System Cost (installed)	Annual Revenue	Simple Payback (Years)
1.0	$ 4,900	$ 139	35.3
5.0	$ 24,500	$ 913	26.8
10.0	$ 49,000	$ 2,005	24.4
15.0	$ 73,500	$ 3,120	23.6
20.0	$ 98,000	$ 4,242	23.1
25.0	$ 122,500	$ 5,367	22.8

Figure 6.2: Estimated Simple payback for PV System installed in Yukon on a residential building with an assumed installed cost of $4.90/Watt

Assuming that the trend of decreased installation system costs continues, these paybacks will improve over time. Figure 6.3 below shows the relationship between simple payback and installed PV system costs for a 5 kW system given the same assumptions as above.

Installed System Cost ($/Watt)	5 kW System Cost (installed)	Annual Revenue	Simple Payback (Years)
$ 2.00	$ 10,000	$ 913	11.0
$ 2.50	$ 12,500	$ 913	13.7
$ 3.00	$ 15,000	$ 913	16.4
$ 3.50	$ 17,500	$ 913	19.2
$ 4.00	$ 20,000	$ 913	21.9
$ 4.50	$ 22,500	$ 913	24.7
$ 5.00	$ 25,000	$ 913	27.4
$ 5.50	$ 27,500	$ 913	30.1
$ 6.00	$ 30,000	$ 913	32.9

Figure 6.3: Estimated Simple payback for a 5 kW PV System installed in the Yukon on a residential building with varying installed system costs.

It is clear from this table that there is a strong relationship between installed system costs and simple payback. Decreases in installed system costs with the potential for increased electrical rates over the next 10 years are likely to compound to make PV systems increasingly economically attractive in the future. At this time, it's fair to say that for the utility customer who may wish to install such a system today, paybacks are likely to be greater than 20 years.

8. Conclusions

Grid connected PV systems have been in operation in Yukon for nearly 13 years with successful results. This report catalogues the performances of three such systems over the course of five years and shows definitively that this technology works well in Yukon's harsh northern environment. Over the course of monitoring, these systems have required no maintenance or intervention to maintain their performance and have typically performed as predicted.

The systems have shown significantly strong performance through the months of March through September with reasonable performance in February, October and November and generally poor performance in December and January. While this performance characterization does not match the peak electrical demands the territory sees during the coldest months of the year, it does offer excellent performance when the territory's hydro resources are depleted right before the spring freshet begins to revive these reserves.

Economically, PV systems are competitive in remote regions reliant on diesel generation and may compare favourably with LNG in the future depending on the trends in pricing of both PV system installations and natural gas. PV systems will likely never be economically competitive with legacy hydro generation which weakens the current economic argument for residential/commercial scale installations on the YIS. Decreasing installation costs, increasing demand for new generation options and increasing electrical rates may act to improve the economic rationale for this technology in Yukon.

9. Next Steps

ESC will continue to monitor the performance of these three systems and has recently begun planning the monitoring of three new systems in more remote areas of the territory: one in Burwash Landing and two in Old Crow. These new systems, combined with our current and expanding knowledge of the Watson Lake and Whitehorse area systems, will help to give Yukoners a more fulsome understanding of the potential for this technology in the territory. ESC will continue to monitor the installation costs of PV both inside and outside of the territory and report on the latest advances in both technology and economic viability for solar technologies.